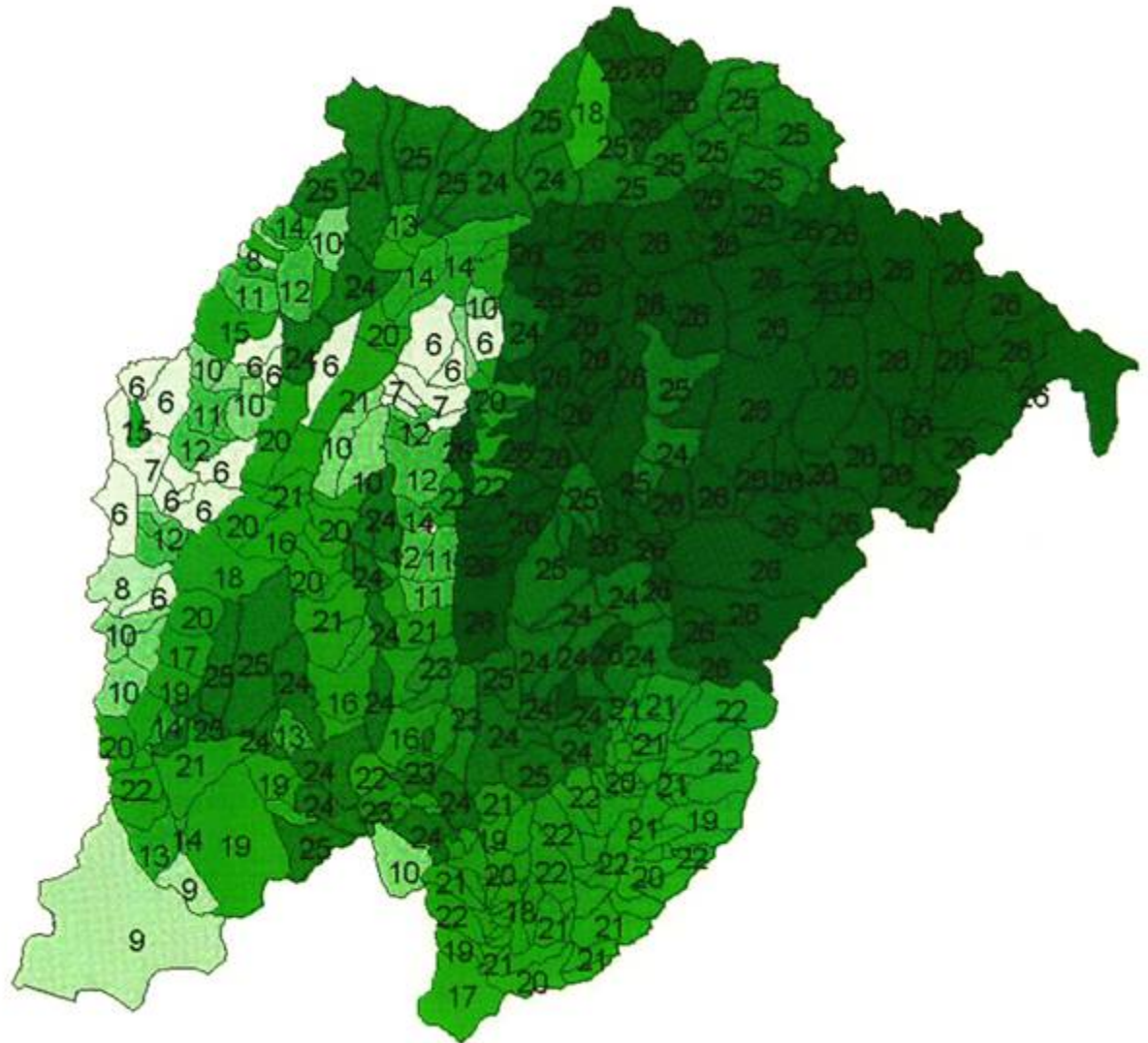# Watershed Condition Assessment: *What are They & Why are They Important to Natural Resource Management?*

Eric Stein

S. Ca. Coastal Water Research Project (SCCWRP)
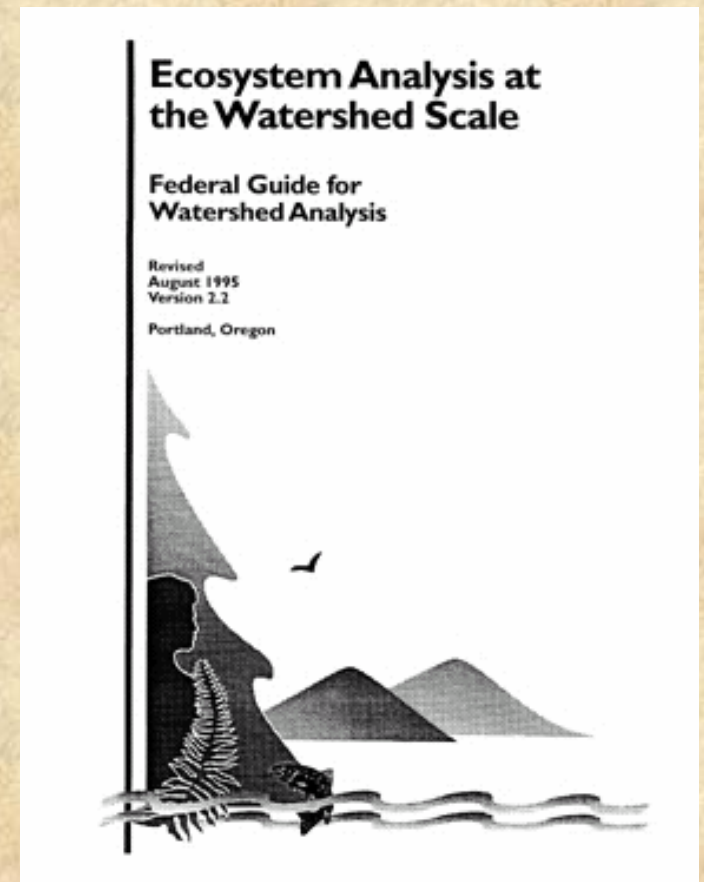
Today's Presentation

- What is watershed assessment?
  - Assessment vs. monitoring

- Key elements and approaches to assessment
  - Scale
  - Indicators
  - Reference

- Sample applications

- Conclusions and considerations

Why do People Assess?

- Common language to communicate condition

- Structured framework to aid decision-making
  - ✓ Understand the systems that are being managed
  - ✓ Assess trends over time
  - ✓ Standardized approach for evaluation of conservation or management actions
  - ✓ Assess program success or compare program performance
  - ✓ Provide an early warning of potential decline of system integrity
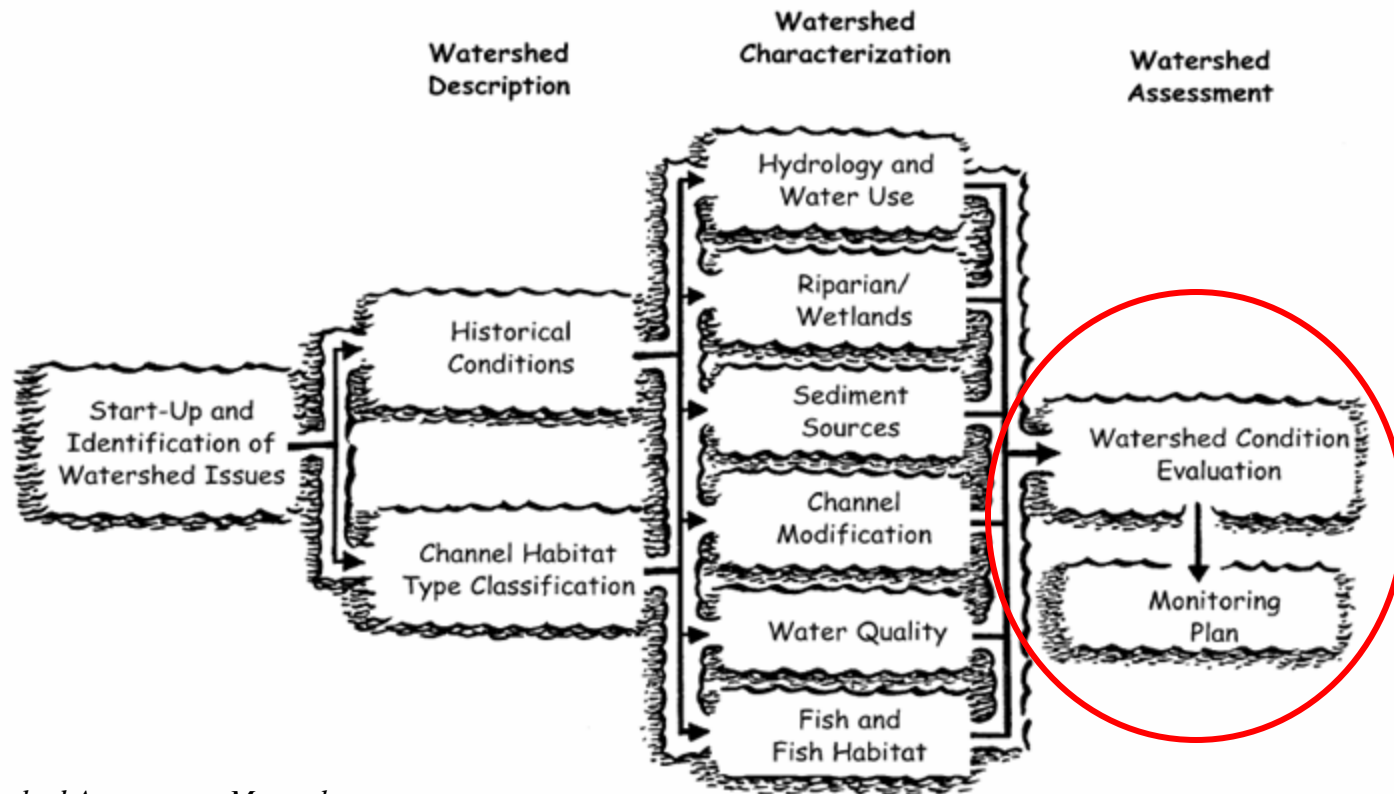
What is Watershed Assessment?

- Procedure to characterize features, conditions, processes, and interactions within a defined geographic area

- Provides a systematic way to understand and organize information about the natural environment

- Not a decision-making process, rather a stage-setting process to establish the context for decision making

Ecosystem Analysis at the Watershed Scale

Federal Guide for Watershed Analysis

Revised
August 1995
Version 2.2

Portland, Oregon

Goals of Watershed Assessment

- The main goal is to characterize current and past watershed conditions for the purposes of watershed protection, restoration, and resource management planning.

- Watershed assessments inherently contain hypotheses about
  - cause-effect relations between activities and watershed conditions
  - reference watershed conditions
  - linkages among activities
  - habitat conditions

- Assessments can provide the basis for watershed-level planning, management and policy decisions and can lead to more detailed watershed analyses and development of prescriptions at the site scale.

North Coast (CA) Watershed Assessment Plan

Assessment Process

Oregon Watershed Assessment Manual

Data collection/compilation

Data application and interpretation

Assessment vs. Monitoring

- **Assessment** is a process for analyzing current or past condition and the likely causes of these conditions in order to guide the decision-making process

- **Monitoring** is a process for evaluating the effectiveness of management actions, trends over time and tests validity of assumed cause-effect relationship

Assessment

⬇

**Decision-making
Goals & Objectives
Desired Future Conditions**

⬇

Monitoring

Conceptual Approach
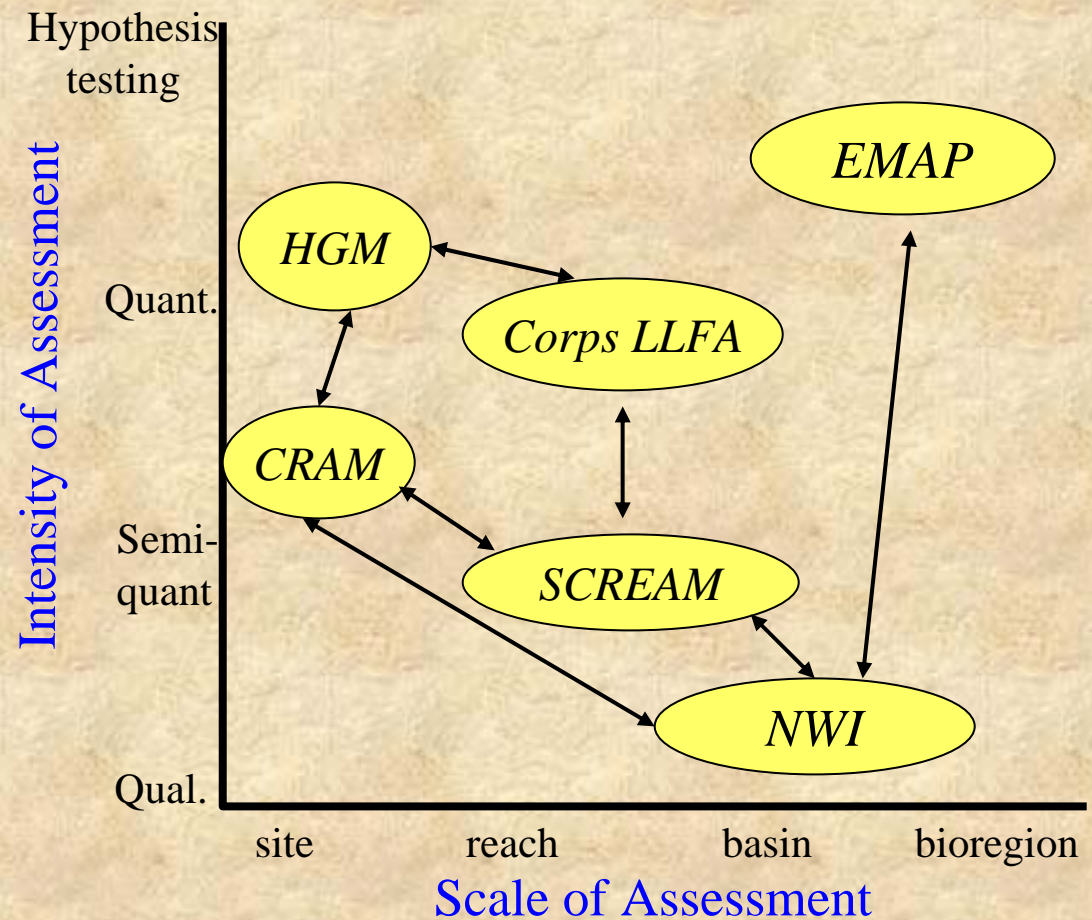
Condition

↕

Function

Stressors
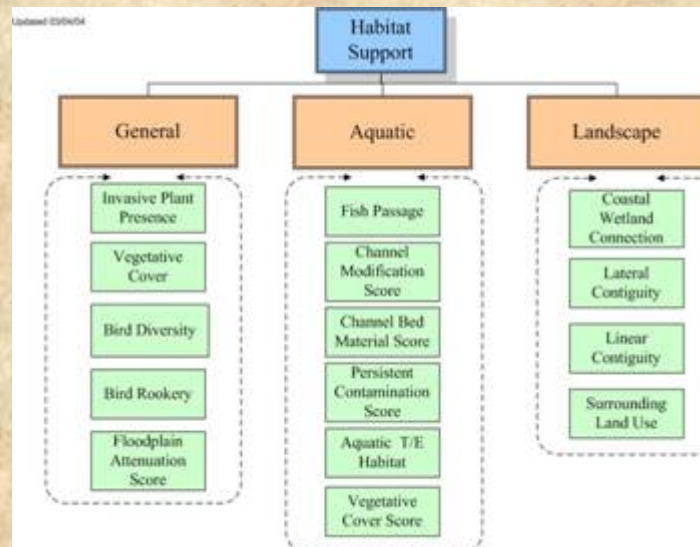
Metrics or indictors

✓ Scaled relative to reference

✓ Combined

✓ Calibrated with field data

Types of Assessment Methods

- GIS-based methods

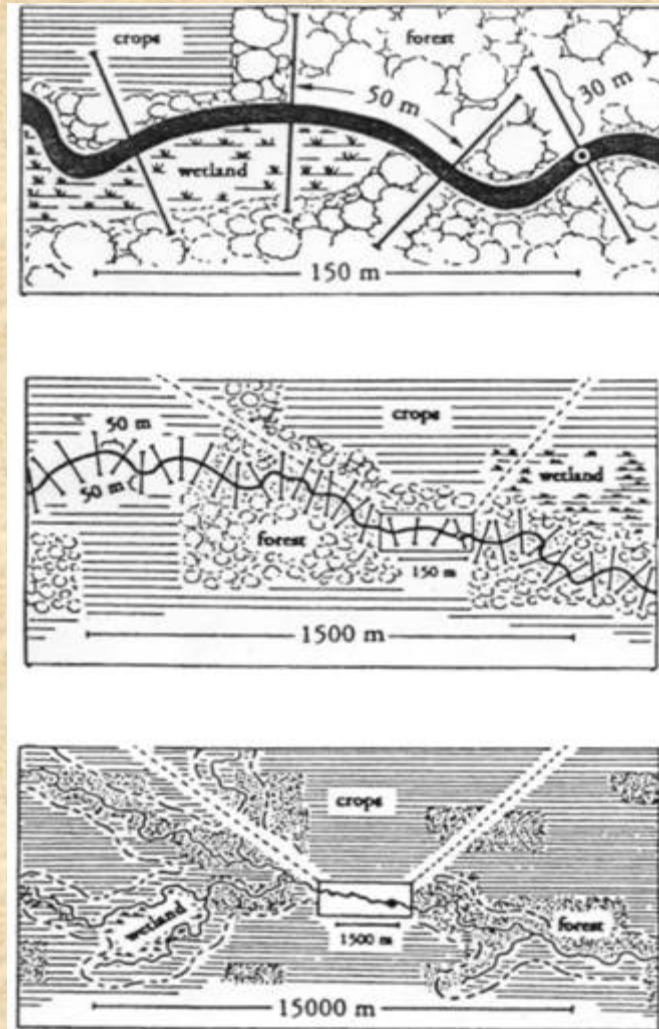- Field-based methods

- Combination methods

Hypothesis testing

Intensity of Assessment

Quant.

Semi-quant

Qual.

HGM

Corps LLFA

EMAP

CRAM

SCREAM

NWI

site   reach   basin   bioregion

Scale of Assessment

After: R. Dan Smith

Scales of Assessment

- Regional or watershed

- Community or ecosystem

- Population or site

- Species

Frissell et al., 1986

Strategies for Assessment

- Ecologic indictors of condition
  - Quantitative $\dashrightarrow$ Qualitative
  - Objective $\dashrightarrow$ Subjective
  - Rationale documented $\dashrightarrow$ Undocumented

- Value or importance based on certain criteria

- Potential to meet defined objective (e.g. restoration)

- Degree of stressors or risk

Reference = A Range of Conditions
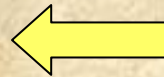
What is an Appropriate Reference Standard Condition?

"culturally unaltered"
vs
"best attainable"

The LA River near downtown LA~circa 1900.

Types of Indicators

- Habitat structure, diversity, complexity
  - Response guilds

- Hydrology or geomorphology

- Biogeochemistry or water quality

- Landscape context
  - Connectivity

- Stressors

Indicators at Different Spatial Scales

Urbanization causes the temperature of streams to rise, both during low flow and storm events.

Copyright 2000, Center for Watershed Protection

8% Impervious Cover

20% Impervious Cover

76% Impervious Cover

What Makes a "Good" Indicator?

- Reflective of condition or function
- Sensitive to change in condition or function
- Structured around a clear desired endpoint/optimum condition
- Include biological, physical, chemical indicators
- Clear and unambiguous
- Can be assessed rapidly
- Include indicators that assess multiple scales
- Linked to specific stressors that can be realistically managed
- Based on a range of reference conditions across range of disturbance gradient

Brooks et al., 1998

Sample Applications

- Field-based Method (CRAM)

- GIS-based Method (SCREAM)

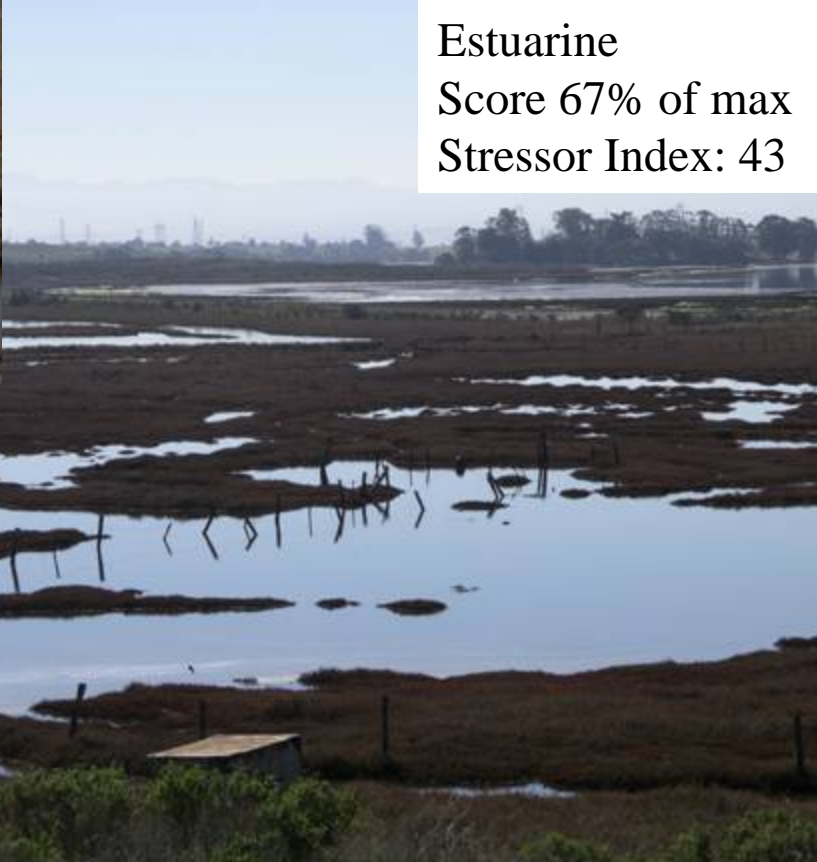- NPS Coastal Watershed Condition Assessment

Features of the
Ca. Rapid Assessment Method (CRAM)

- Field-based method
- Applicable to all wetland types in Ca.
- Regionalized
- Assess condition based on 4 attributes
  - Buffer and landscape context
  - Hydrology
  - Abiotic structure
  - Biotic structure
- 16 metrics distributed across the 4 assessment attributes
- Stressor checklist
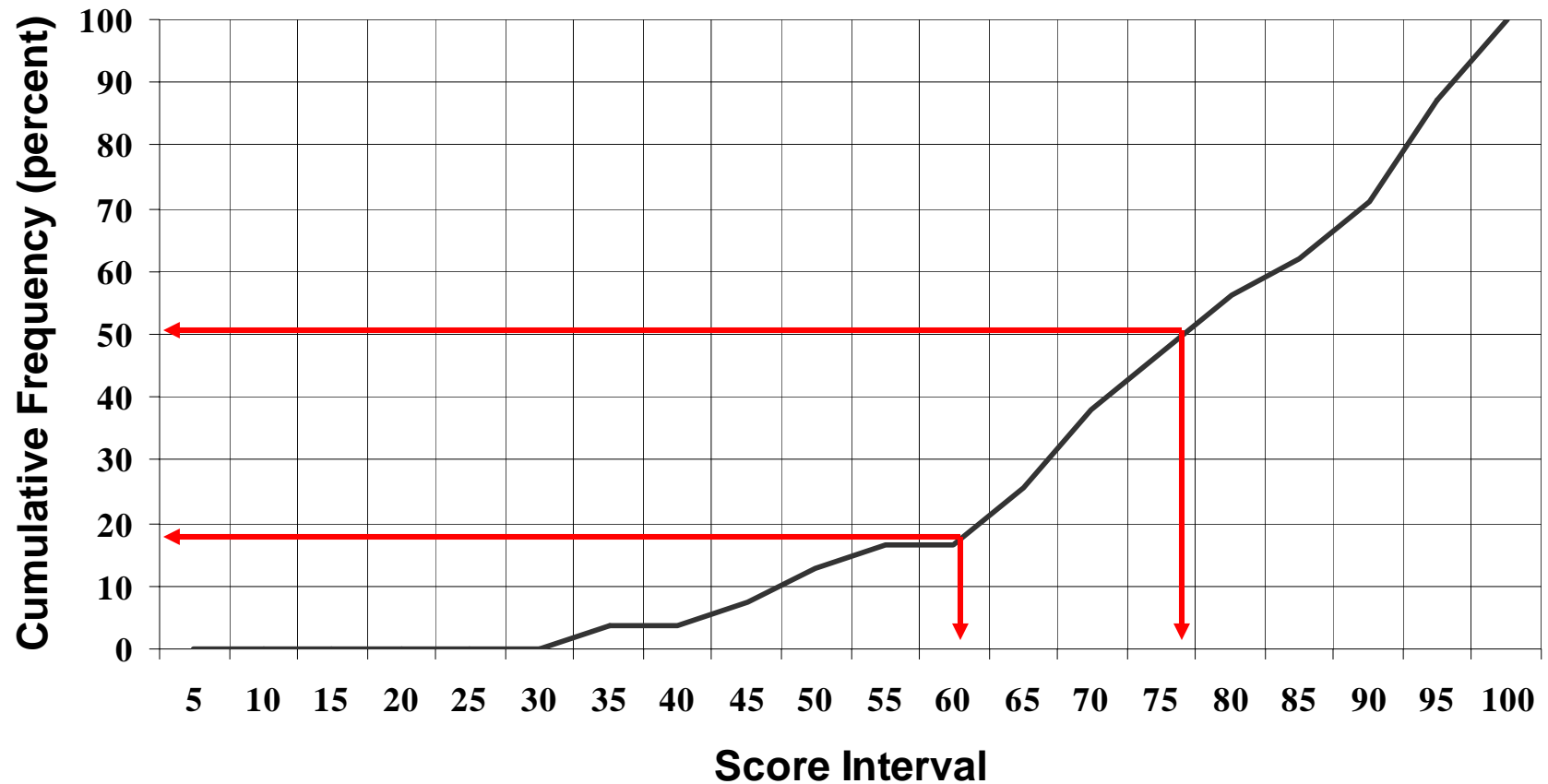
CRAM Field-based Assessment
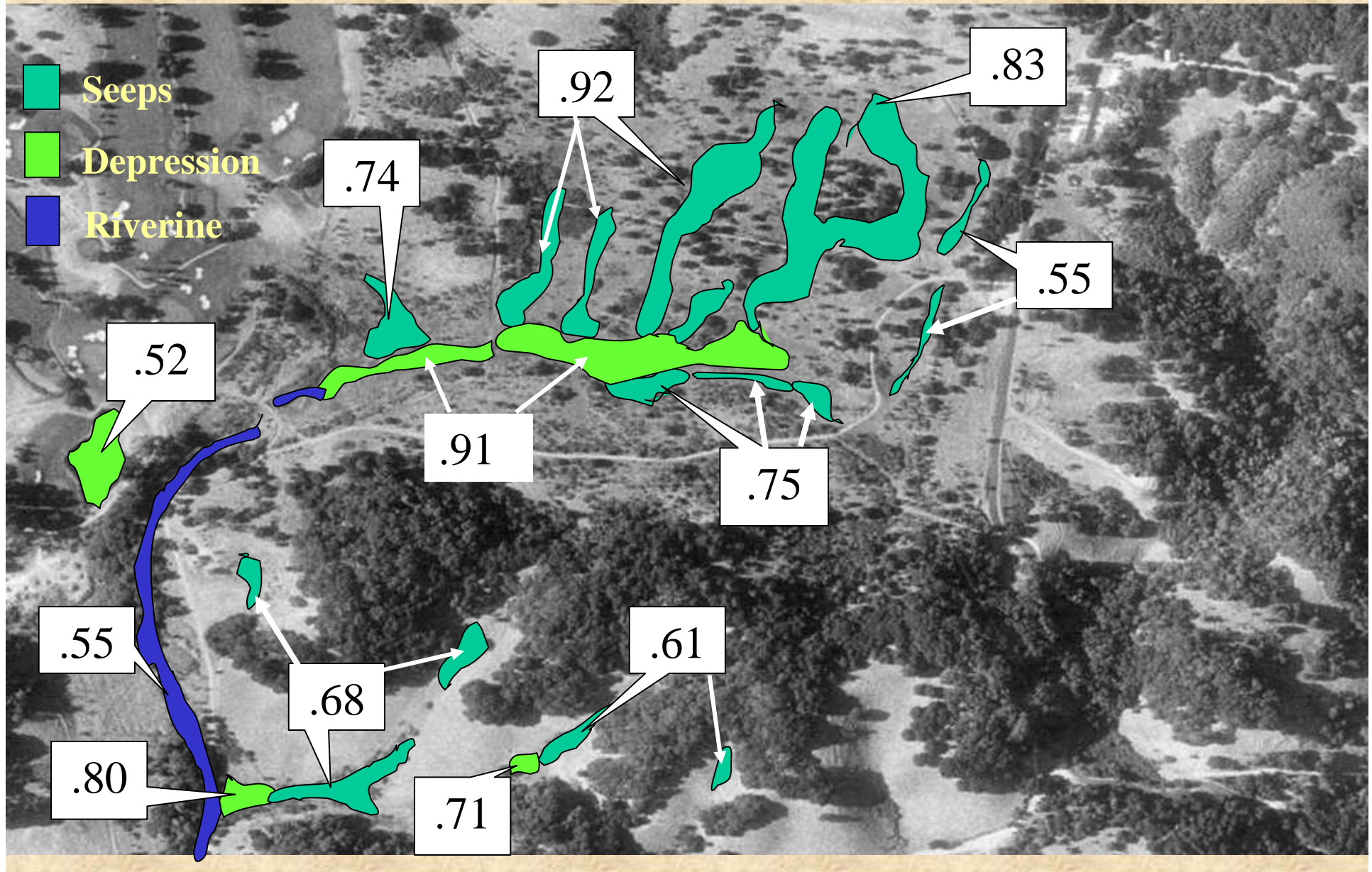

Estuarine
Score: 82% of max
Stressor Index: 15

Estuarine
Score 67% of max
Stressor Index: 43

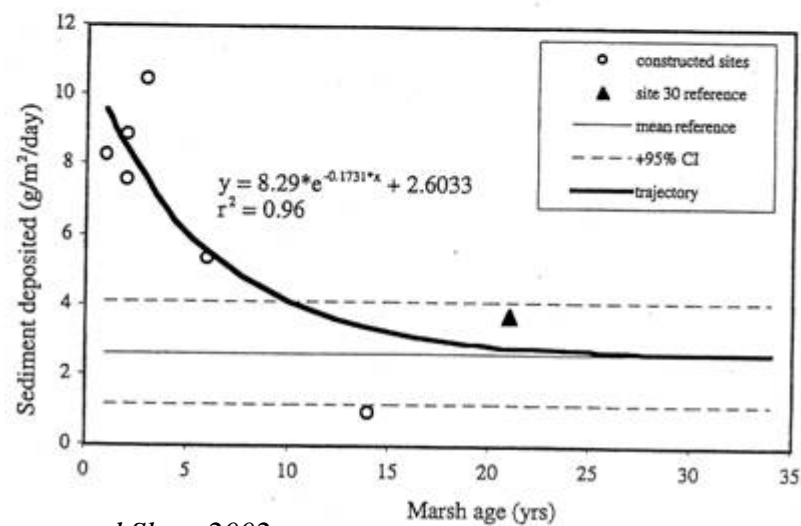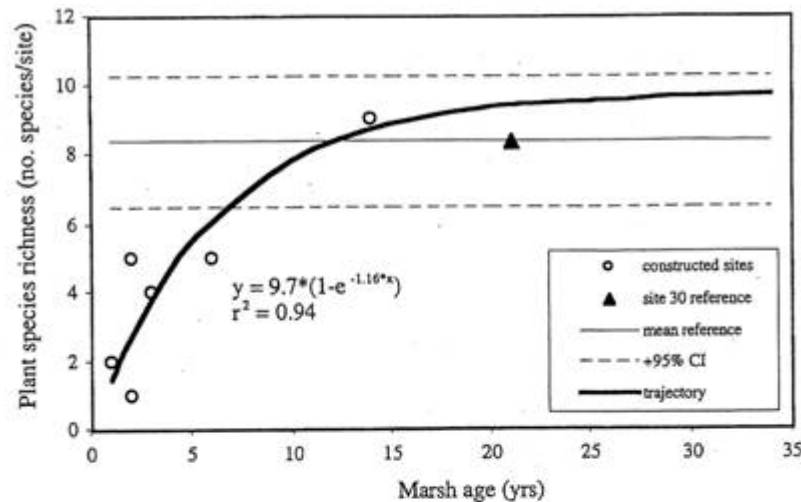# Sample Application of CRAM for Regional Assessment

Cumulative Distribution of Site Scores
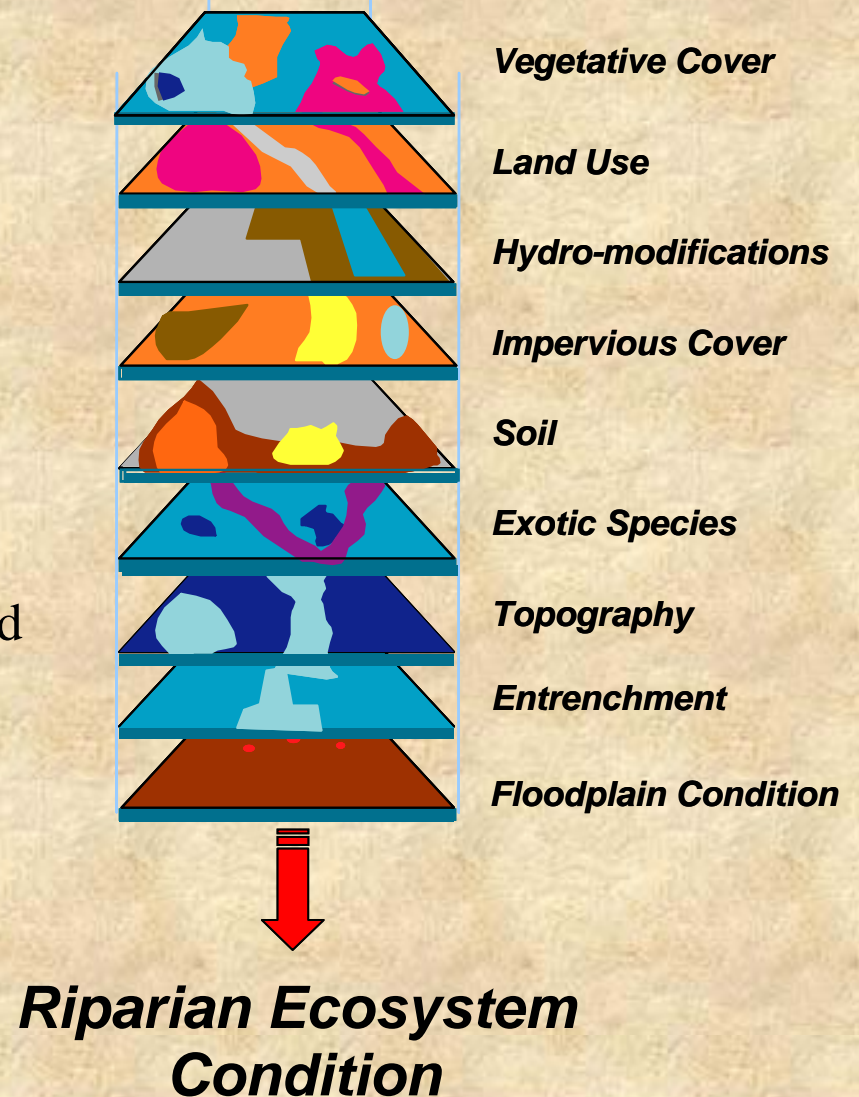
Application of CRAM for Watershed Profiles

Application of Assessment to Restoration Monitoring

Morgan and Short 2002

Features of the S. Ca. Riparian Ecosystem Assessment Method (SCREAM)

- Geographic information system (GIS)-based model
- Landscape-scale
- Uses remote sensing and (limited) field data to assess riparian condition in a watershed
- User-friendly model interface and graphical output
- Uses 22 metrics to assess condition based on <u>habitat, hydrology and biogeochemistry</u>
- Developed in partnership with NOAA-CSC

Vegetative Cover

Land Use

Hydro-modifications

Impervious Cover

Soil

Exotic Species

Topography

Entrenchment

Floodplain Condition

Riparian Ecosystem Condition

SCREAM Output

- Landscape View of Vegetative Cover…

- Tabular output

- Habitat Condition Score for the UA, Reach, Catchment or Watershed
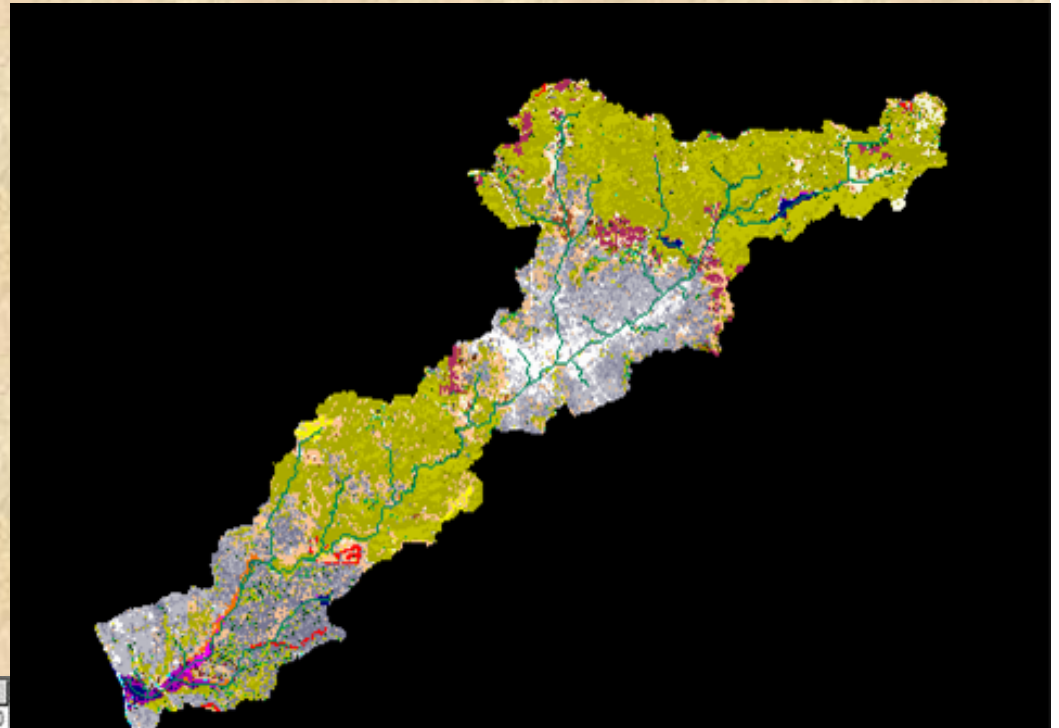
shape*	OBJECTID*	Upstream	streaml	seglength	strahler	flag	HB6	HB7	HB15
Polygon	1	0	1	165.63183	1	0	0	0	0
Polygon	2	0	2	300	1	-1	0	0	0
Polygon	3	2	2	330.62445	1	1	0	0	0
Polygon	4	0	3	300	1	-1	0	0	0
Polygon	5	4	3	300	1	-1	1	4.7619	1
Polygon	6	5	3	300	1	-1	0	0	0
Polygon	7	6	3	300	1	-1	0	0	0
Polygon	8	7	3	300	1	-1	0	0	0
Polygon	9	8	3	300	1	-1	0	0	0
Polygon	10	9	3	299.28068	1	2	0	0	0
Polygon	11	10	3	300	1	-1	0	0	0
Polygon	12	11	3	300	1	-1	0	0	0
Polygon	13	12	3	300	1	-1	0	0	0
Polygon	14	13	3	300	1	-1	0	0	0
Polygon	15	14	3	191.96618	1	0	0	0	0

Application of SCREAM for Restoration Prioritization

Linear Continuity Score 2

|	
🟥	0-0.20
🟧	0.21-0.40
🟩	0.41-0.60
🟦	0.61-0.80
🟦	0.81-1.00
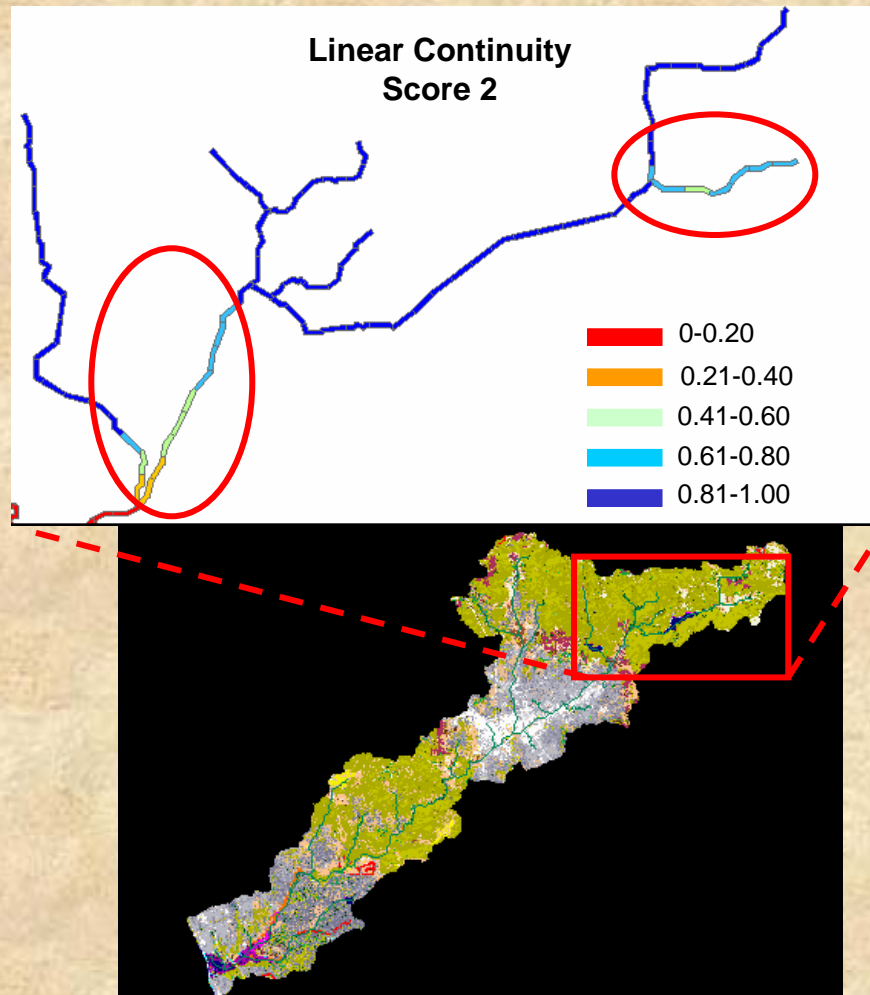
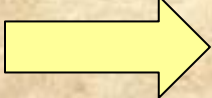**Where should we restore wildlife corridors?**

Linear continuity shows where the breaks are in natural habitat along stream corridor

Aids in identification of restoration opportunities

Restoration Planning Based on Sediment Condition

Upper Gabino

Middle Gabino

Lower Gabino

Preserve
Sediment Deposition
Floodplain restoration
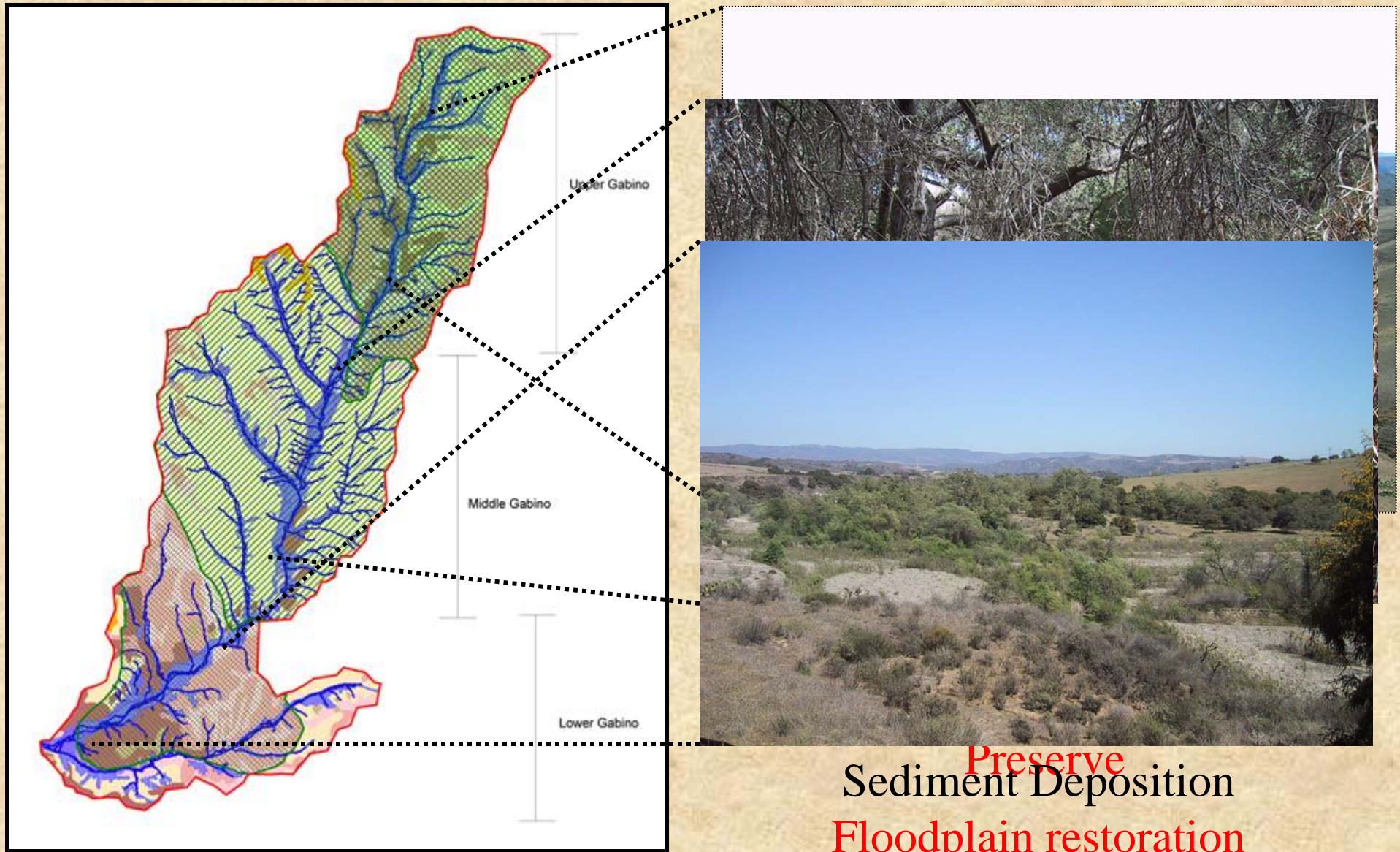
NPS Coastal Watershed Condition Assessment: Phase I Reports

- Describe coastal water resources (marine, estuarine, island)
- Determine state of knowledge on their condition using existing data
- Identify information gaps
- Draw a conclusion or hypothesis re: relative condition (unknown, degraded, unimpaired)
- Identify resource threats or potential issues affecting ecosystem health
- Recommend further studies, if needed (Phase II)

- Land Use Patterns & Trends
- Water Quality Data & Assessments
- Biological Inventories and Studies
- Habitat Quality Assessments
- Invasive Species Issues
- Resource Utilization Issues
  - coastal and offshore development
  - commercial and recreational fisheries
  - recreational use

Coastal Watershed Condition Assessments: Examples of Results

- Cape Lookout NS: Current resource condition is good. Stressors (algae, pathogens, invasive species, nutrients, metals, etc.) concern park management to varying degrees [see next slide]

- Padre Island NS: Physical changes to coastal environment dramatically altered salinity patterns and affect seagrass community composition

- Cumberland Island NS: Low DO concentrations (bayside) are a concern to park management and the state; mosquito control/drainage significantly altered coastal wetland habitats

Threat Matrix:Core Banks, Cape Lookout NS

Stressor	Ocean Beach	Sound Shore	Tidal Creeks	Wells	Ponds
Algal Blooms	LP	LP-PP	PP	LP	ND
Toxic Algae	LP	LP-PP	PP	LP	ND
Nutrients	LP	LP-PP	MP	MP	ND
Fecal Bacteria	LP	LP-PP	LP	LP	ND
Metals	HP (Hg)	HP (Hg)	PP (Hg)	ND	ND
Toxicants	ND	ND	ND	ND	ND
Invasive sp.	PP (lionfish)	LP	LP	LP	ND
Habitat Disruption	PP vehicles	LP	LP	LP	ND

Mike Mallin, PhD, UNCW

Conclusions

- Condition assessment is simply a structured way to apply best professional judgment and existing data

- Provides common language/terminology

- Framework for making decisions

- Good methods are:
  - ✓ Iterative
  - ✓ Inclusive
  - ✓ Adaptive

- Many assessment methods exist . . . .
    (differing levels of detail and sophistication)

Considerations in Selecting a Method

- Identify key management endpoints
    - (e.g. water quality, sensitive spp habitat, corridors)

- Choose an assessment method that contains indicators that are relevant for the key management endpoints

- Choose an assessment method that is appropriate for the spatial AND temporal scale of the watershed you are investigating

- The reference condition used by the assessment method should be relevant for the type of system being assessed and the desired endpoints

Available Resources

- Guidebooks for how to conduct watershed assessment
- Conceptual approaches or strategies for assessment
- Field protocols for data collection
- Numerical simulation models
- Sample planning or case studies (may or may not include a specific assessment method)
- Reviews or critiques of assessment methods
- Scientific studies relevant to assessment (e.g. effect of land-use on amphibian populations)
- Classification systems
- Assessment method details and procedures
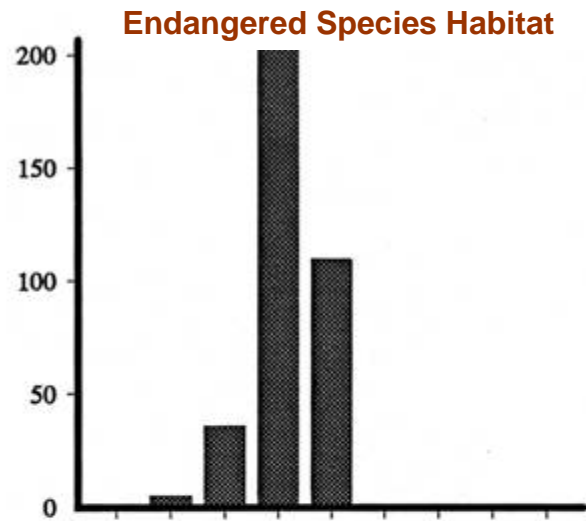
Questions or Comments?

Eric Stein – Southern Ca. Coastal Water Research Project
714-372-9233   erics@sccwrp.org

	Pre-Project Rank	Post Project Rank	Impact Score
Endangered Species	C	B	-
Structural Diversity	C	A	- -
Spatial Diversity	D	C	-
Undeveloped Open Space	B	C	+
Adjacent Land Use	E	B	- - -
Linear Contiguity	B	B	O

Distribution of Impact Scores
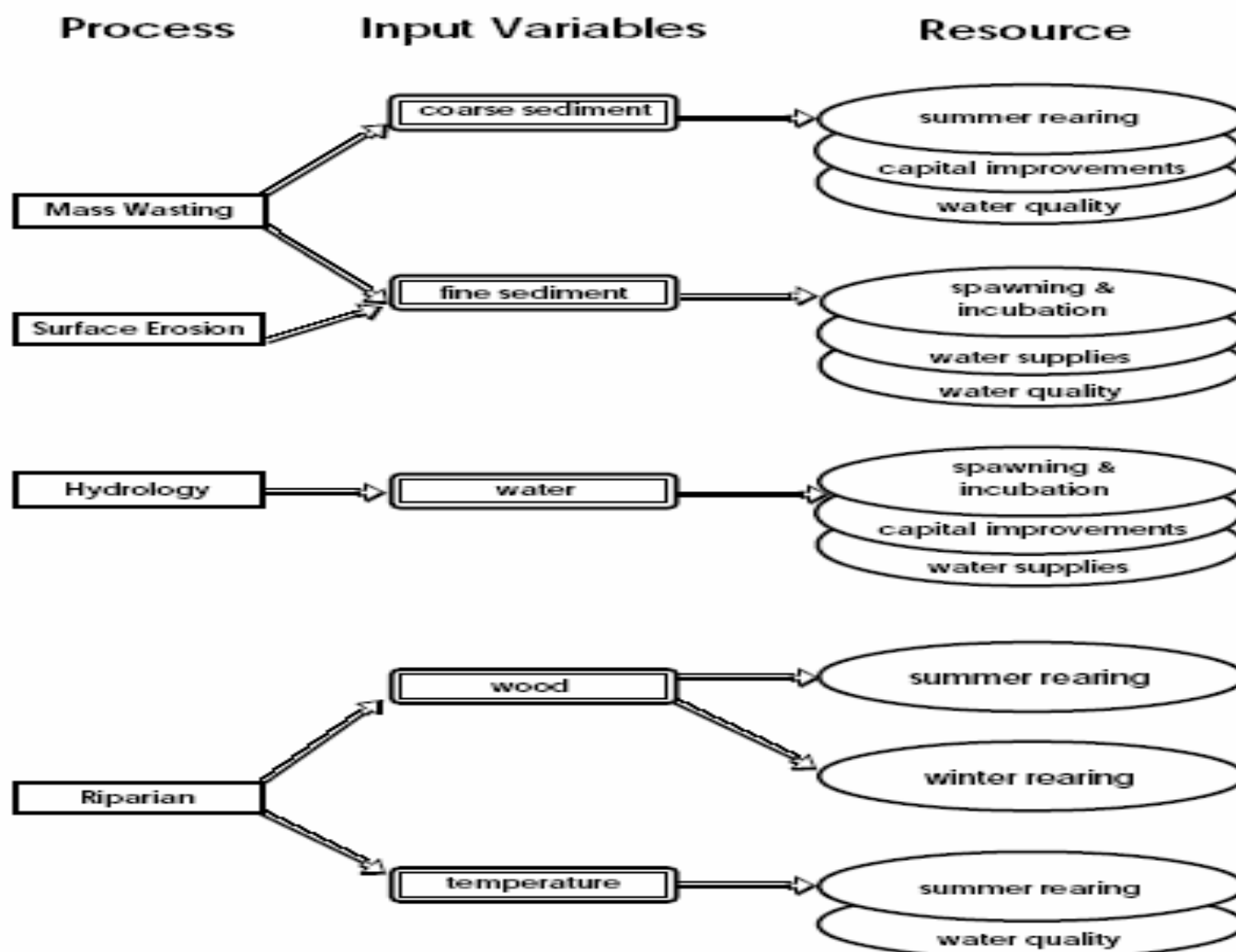
Process   Input Variables   Resource
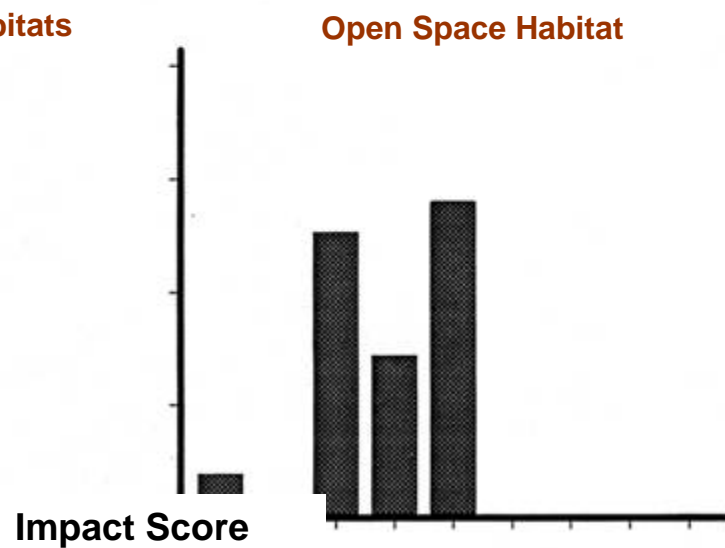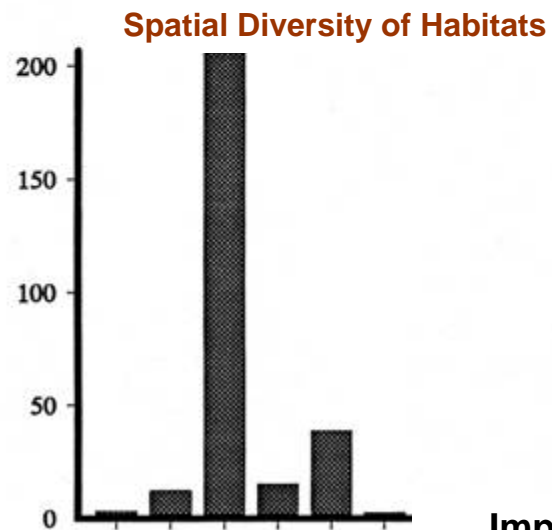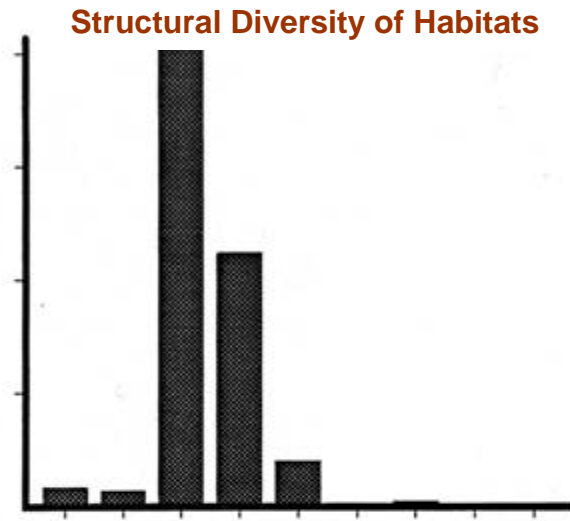
Figure I-4. Relationships among watershed processes, input variables, and effects on public resources.